

# Patterns of Gastroesophageal Reflux in Health and Disease

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Twenty-four-hour pH monitoring of the distal esophagus quantitates gastroesophageal reflux in a near physiologic setting by measuring the frequency and duration of acid exposure to the esophageal mucosa. Fifteen asymptomatic volunteers were studied with 24-hour pH and esophageal manometry. The normal cardia was more competent supine than in the upright position. Physiologic reflux was unaffected by age, rarely occurred during slumber, and was the rule after alimentation. One hundred symptomatic patients with an abnormal 24-hour pH record (2 S.D. above the mean of controls) could be divided into three patterns of pathological reflux: those who refluxed only in the upright position (9), only in the supine position (37), and in both positions (54). Upright differed from supine refluxers by excessive aerophagia causing reflux episodes by repetitive belching. Compared to controls, they had excessive post-prandial reflux, lower DES pressure, and less DES exposed to the positive pressure of the abdomen. Supine differed from upright refluxers by having a higher incidence of esophagitis and an inability to clear the esophagus of acid after a supine reflux episode. Compared to controls, they had only a lower DES pressure. Combined refluxers had a higher incidence of esophagitis than supine refluxers. Stricture (15%) was seen only in this group. They were similar to supine refluxers in their inability to clear a supine reflux episode. Compared to controls, they had a lower DES pressure and less DES exposed to the positive pressure of the abdomen. Forty of the 100 patients had an antireflux procedure (4 upright, 8 supine, 28 combined). The most severe postoperative flatus and abdominal distention was seen in the upright refluxers. It is concluded that minimal reflux is physiological. Patients with pathological reflux all have lower DES pressure. Patients with upright reflux have less of their DES exposed to the positive pressure environment of the abdomen. Patients with supine reflux have an inability to clear the esophagus of reflux acid and are prone to develop esophagitis. Patients with both upright and supine reflux have the most severe disease and are at risk in developing strictures. In patients with only upright reflux, aerophagia and delayed gastric emptying may be an important etiological factor.

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GASTROESOPHAGEAL REFLUX is experienced occasionally by every individual, but in some its occurrence reaches a level where it is responsible for symptoms of heartburn and regurgitation. Not all these symptomatic individuals develop endoscopic esophagitis. The variable effects of gastroesophageal reflux have defied explanation until the development of 24-hour pH monitoring of the distal esophagus.<sup>3</sup> This test allows one to quantitate the degree of gastroesophageal reflux in a near physiological setting by measuring the frequency and duration of acid exposure to the esophageal mucosa and the length of time required to clear the esophagus of acid following a reflux episode. In addition, it allows one to record the symptoms that occur simultaneously with an episode of reflux. It actually combines three tests in one. It is a quantitative pH reflux test, an acid clearing test, and an acid perfusion test. In this study, 24-hour pH monitoring of the distal esophagus was used to evaluate the amount and character of gastroesophageal reflux that occurred in 15 asymptomatic volunteers and 100 symptomatic patients. Three patterns of abnormal reflux were identified and related to characteristics of the distal esophageal sphincter, the development of esophagitis, and the results of surgical antireflux procedures.

## Methods

Twenty-four-hour pH monitoring of the distal esophagus was evaluated in two groups of individuals. The first

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TABLE 1. *Symptoms of Gastroesophageal Reflux*

Heartburn-(Flow of Gastric Contents into Esophagus)		
None	- 0 -	No heartburn
Minimal	- 1 -	Occasional episodes
Moderate	- 2 -	Reason for medical visit
Severe	- 3 -	Interference with daily activities
Regurgitation-(Flow of Gastric Contents into Mouth)		
None	- 0 -	No regurgitation
Minimal	- 1 -	Occasional episodes
Moderate	- 2 -	Predictable on position or straining
Severe	- 3 -	Episodes of Pulmonary Aspiration
Dysphagia		
None	- 0 -	No dysphagia
Minimal	- 1 -	Occasional episodes
Moderate	- 2 -	Required liquids to clear
Severe	- 3 -	Episode of meat impaction requiring medical treatment

Note: value for heartburn + regurgitation + dysphagia = total symptomatic score.

group consisted of 15 asymptomatic volunteer subjects who gave no history of gastroesophageal reflux symptoms and had no prior history of antacid therapy or had not received an upper gastrointestinal series for digestive symptoms. They comprised elective admissions to Tripler Army Medical Center for an inguinal hernia repair and other non-gastroenterologic illnesses.

The second group consisted of 100 consecutive patients admitted to Tripler Army Medical Center or The University of Chicago Hospitals and Clinics with symptoms of heartburn and regurgitation and in whom an

abnormal 24-hour pH monitoring of the distal esophagus was obtained.

The technique of the 24-hour pH monitoring of the distal esophagus has recently been reported by the authors.<sup>3</sup> It consists of positioning a pH electrode 5 cm above the distal esophageal sphincter previously located by infusion manometry and a reference lead on the forearm using a technique that assures good electrical contact. Both the pH probe and the reference leads are connected via a pH meter to a strip chart recorder running at 6 inches per hour for 24 hours. The entire apparatus is housed in a movable cart at the bedside, allowing the patient freedom to move about. A normal diet is served during this period, unique only in the absence of food and beverages having a pH of less than 5. All the individuals are given a pencil to mark on the strip chart recorder any symptoms that occur, as well as their body position. Reflux was defined whenever the pH in the esophagus dropped to less than 4. From the 24-hour record, the per cent time the pH was less than 4 in the distal esophagus could be determined for the total 24-hour period and for the time spent in the upright and supine positions. In addition, the total number of reflux episodes and the duration of each reflux episode could be obtained from the tracing. From these data, one could calculate the number of reflux episodes per hour in the upright and supine position, and the average duration of an upright or supine reflux episode. The latter is considered esophageal clearance time, that is, the average time necessary for the esophagus to clear itself of refluxed acid.

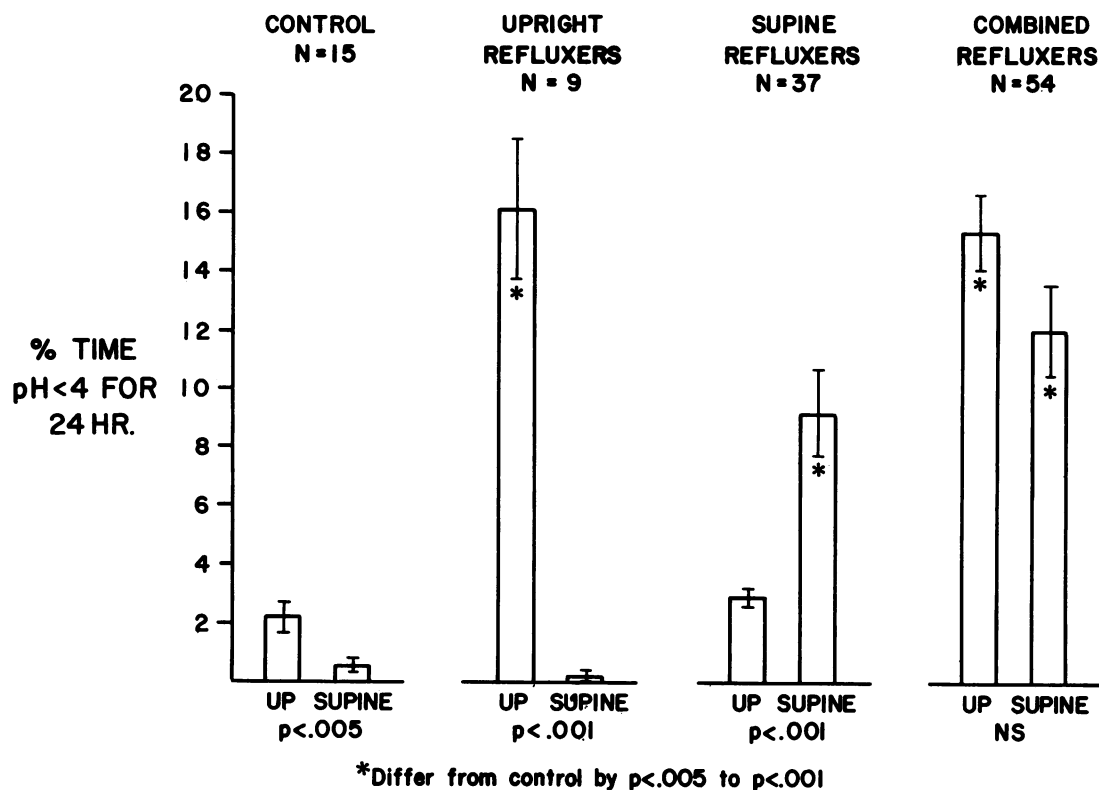
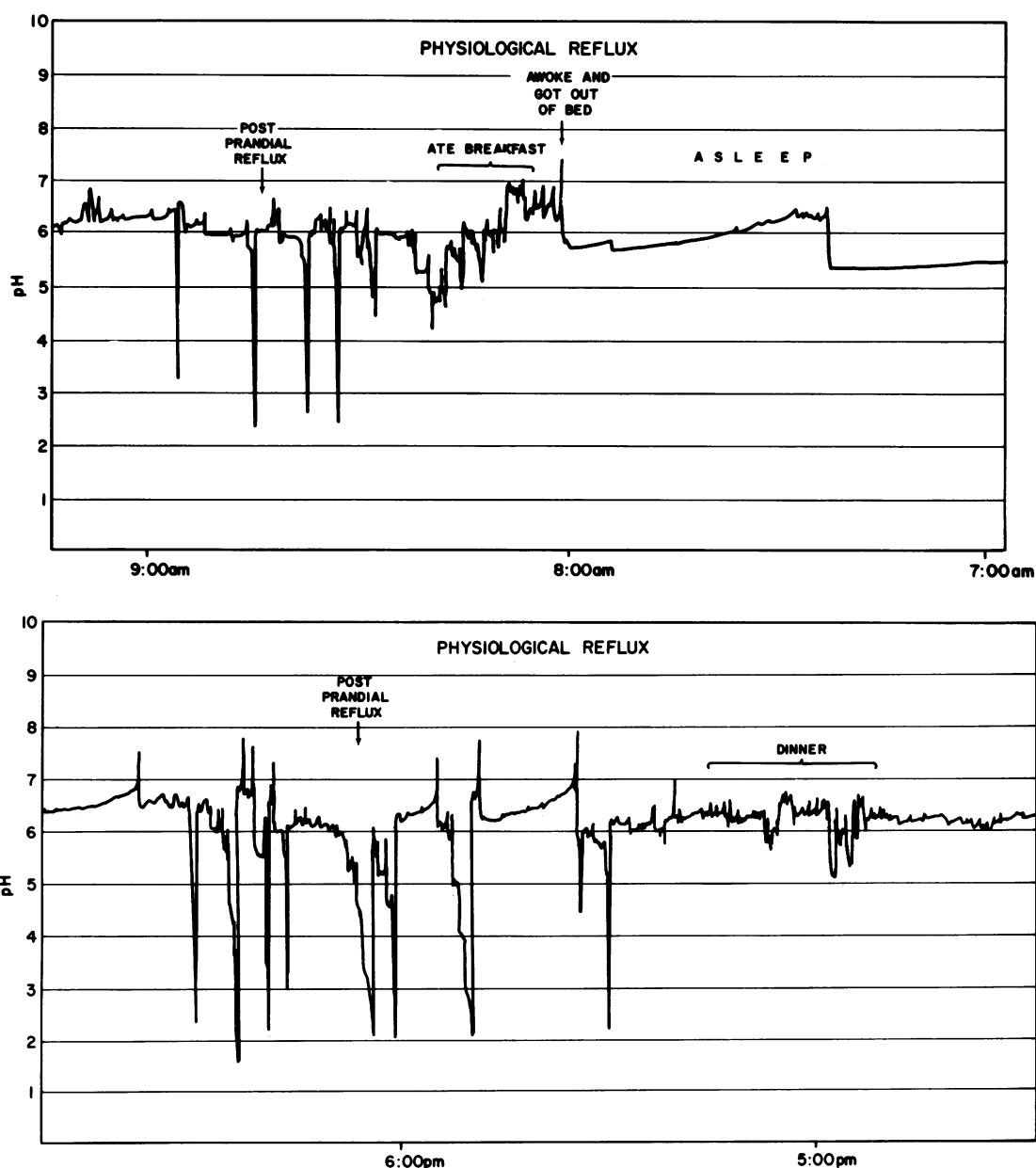


FIG. 1. The results of 24-hour pH monitoring of the distal esophagus in 15 asymptomatic subjects and 100 patients with reflux symptoms.



FIGS. 2a and b. Portion of a 24-hour esophageal pH monitoring record from an asymptomatic subject showing normal physiological reflux. A drop in pH below 4 is considered a reflux episode. (Top) Note the absence of reflux while recumbent and asleep and the post-prandial reflux after breakfast. (Bottom) Note the absence of reflux while upright before dinner and the post-prandial reflux after dinner.

The normal values for the 24-hour pH monitoring were obtained from the 15 asymptomatic volunteer subjects and have previously been reported.<sup>3</sup> All patients with an abnormal 24-hour pH study had a value greater than 2 standard deviations above the mean value obtained in the volunteer subjects for per cent time the pH was less than 4 in the upright or supine positions.

Each individual in both groups underwent a manometric evaluation of his distal esophagus according to the technique described by Winans using a single catheter assembly consisting of three fluid-filled, perfused, polyethylene tubes bonded together with three 2 mm lateral openings placed 5 cm apart at its distal end. The catheter was passed into the empty stomach like a nasogastric tube and withdrawn in 1 cm increments from the stomach

into the esophagus and up into the cricopharyngeus muscle. Using this technique, the location and the resting pressure of the distal esophageal sphincter (DES), the location of the respiratory inversion point, the length of DES below the respiratory inversion point (abdominal esophagus), and the presence of abnormal motility represented by repetitive, spontaneous, simultaneous, and/or powerful broad base esophageal contractions was obtained. The DES pressure was measured as the difference in mm Hg between the resting end expiratory gastric pressure and the sphincter pressure at the respiratory inversion point.

The symptomatic patients were graded on a scale of 0 to 3 for symptoms of heartburn, regurgitation, and dysphagia (Table 1). The grading was done prior to any objective

## FREQUENCY AND DURATION OF REFLUX EPISODES

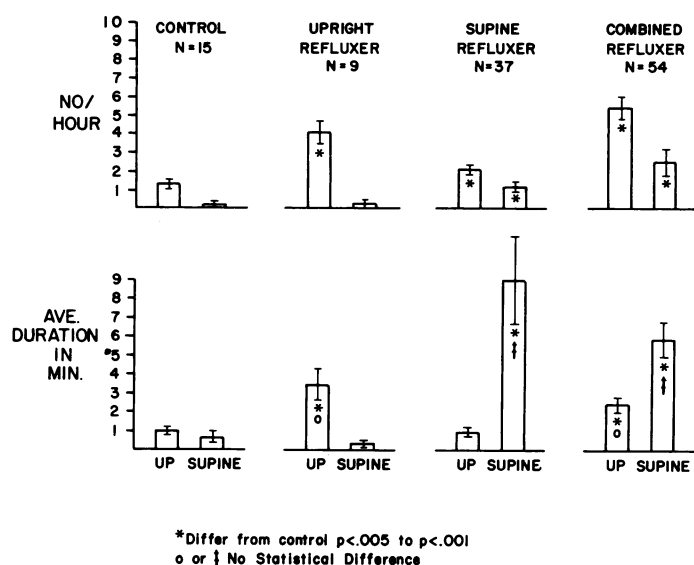


FIG. 3. Frequency and duration of upright and supine reflux episodes calculated from the 24-hour esophageal pH records from asymptomatic subjects and symptomatic patients with various patterns of reflux.

studies using a reflux questionnaire completed by one of the authors during an interview with the patient. The highest obtainable score was 9 and would represent a patient with heartburn that interfered with daily activities, episodes of pulmonary aspiration secondary to regurgitation, and dysphagia requiring hospital admission for relief of meat impaction.

Seventy-three patients of the 100 symptomatic patients underwent esophagoscopy to determine grossly the

presence of esophagitis. The degree of esophagitis was scored as grade I for an erythematous and friable mucosa; grade II for esophageal ulceration; and grade III for the presence of a fibrous stricture.

Forty of the symptomatic patients underwent an anti-reflux procedure consisting of 8 Belsey, 13 Hill, and 17 Nissen repairs. At 4 months after surgery, these patients had a followup esophageal manometry and 24-hour pH monitoring of their distal esophagus, and were evaluated for the presence of postoperative flatus and/or periodic episodes of abdominal distention. In regard to the latter, attempts were made to determine if the episodes of abdominal distention were of sufficient severity to merit the seeking of medical aid and/or decompression with a nasogastric tube.

The T test was used for statistical comparison between the asymptomatic control subjects and symptomatic patients, the various reflux patterns observed in the symptomatic patients, and the pre and postoperative test results.

## Results

Twenty-four-hour pH monitoring of the distal esophagus in asymptomatic normal subjects shows that the gastroesophageal junction is more competent in the supine than the upright position (Fig. 1). Normal or physiologic reflux episodes are asymptomatic, rarely occur during slumber, and are common in the upright position, especially after alimentation (Figs. 2a and b). They are characterized by their short duration due to rapid clearing of the refluxed material from the esoph-

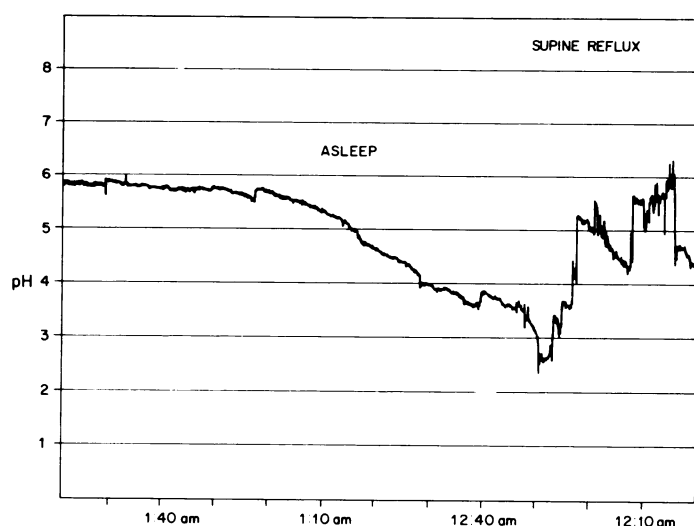


FIG. 4. Portion of the 24-hour esophageal pH monitoring record from a symptomatic patient showing a supine reflux episode during sleep. Note the long duration the esophageal pH remains below 4 and its slow return to a normal pH of 5 to 6.

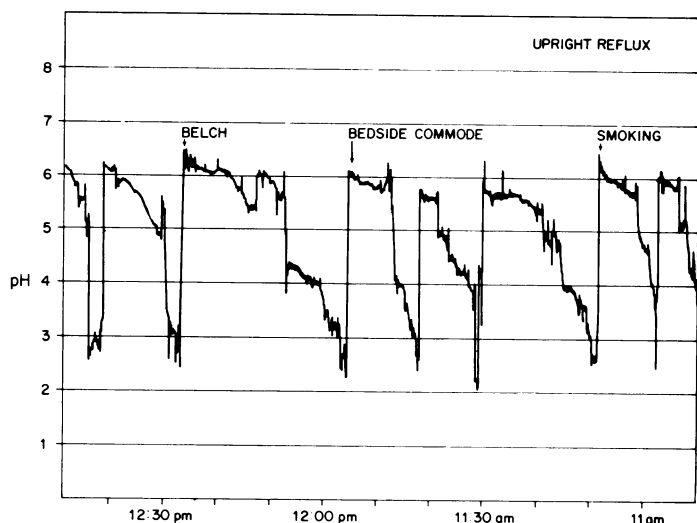


FIG. 5. Portion of a 24-hour esophageal pH monitoring record from a symptomatic patient showing upright reflux episodes with activities that cause increases in intra-abdominal pressure. Note the short duration the esophageal pH remains below 4 and its rapid return to a normal pH of 5 to 6.

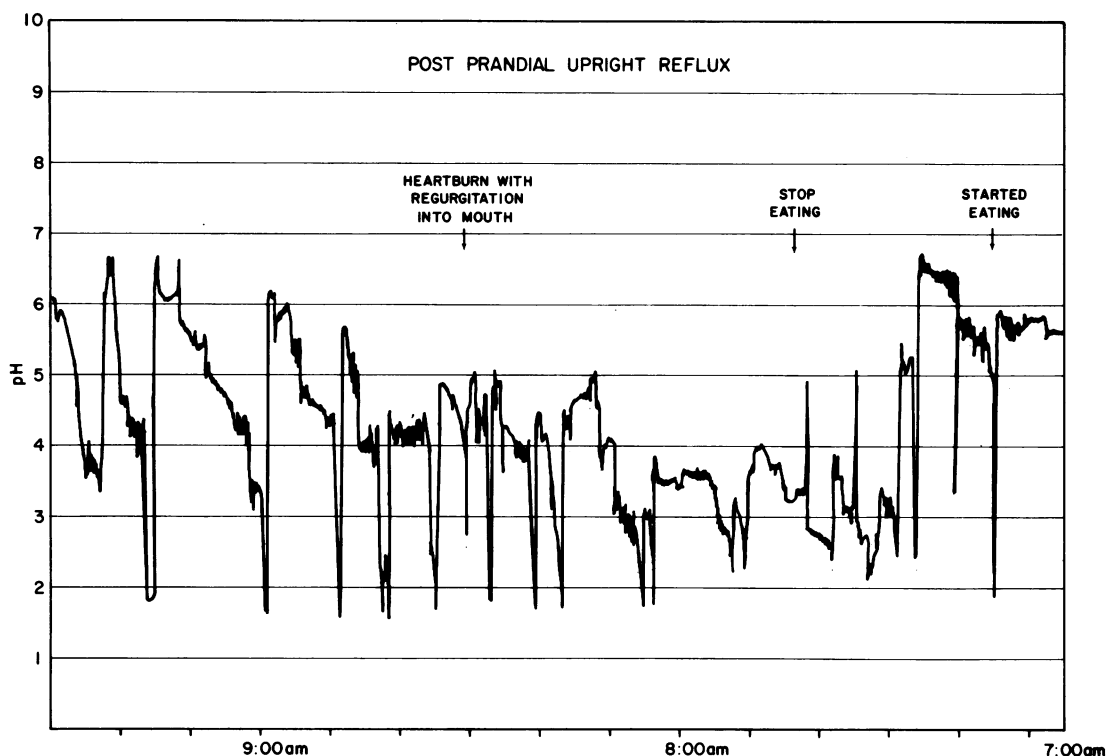


FIG. 6a. Portion of a 24-hour esophageal pH monitoring record from a symptomatic patient with isolated upright reflux showing prolonged and severe post-prandial reflux.

agus by swallowing (Fig. 3). The amount of physiological reflux is unaffected by age.

Patients with symptomatic gastroesophageal reflux can be divided into three distinct patterns of reflux based on 24-hour pH monitoring of the esophagus: those who reflux only in the upright position, termed upright refluxers; those who reflux only in the supine position, termed supine refluxers; and those who reflux in both the upright and supine positions, or combined refluxers (Fig. 1). Of the 100 patients monitored, 54 were combined refluxers, 37 were supine refluxers, and 9 were upright refluxers.

Supine and combined refluxers have supine reflux episodes of long duration, indicating their inability to clear refluxed acid from the distal esophagus during sleep when little swallowing occurs (Figs. 3 and 4).

During the day in the upright position, supine refluxers have statistically more reflux episodes per hour than control subjects, but these reflux episodes are cleared rapidly, and the total per cent time the pH is less than 4 in the upright position is similar to control subjects (Figs. 3 and 1).

Upright and combined refluxers have upright reflux episodes of longer duration than control subjects, indicating their inability to clear refluxed acid from their esophagus following an upright reflux episode (Fig. 3). Upright reflux episodes usually occurred during activities which caused changes in intra-abdominal pressure and were more rapidly cleared from the esophagus by swallowing than supine reflux episodes (Fig. 5). Patients with

only upright reflux were unique in having prolonged and severe post-prandial reflux and excessive aerophagia (Fig. 6, a & b).

The incidence and degree of symptoms of heartburn, regurgitation, and dysphagia are shown for each of the patterns of reflux in Fig. 7. Grade III heartburn was seen only in supine and combined refluxers. Grade III regurgitation, that is, episodes of pulmonary aspiration, occurred with all patterns of reflux. Dysphagia occurred

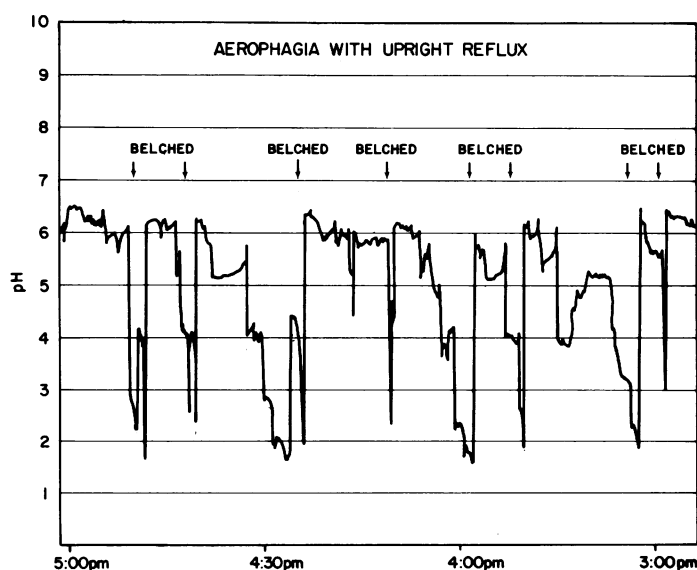


FIG. 6b. Reflux episodes related to belching secondary to excessive aerophagia.

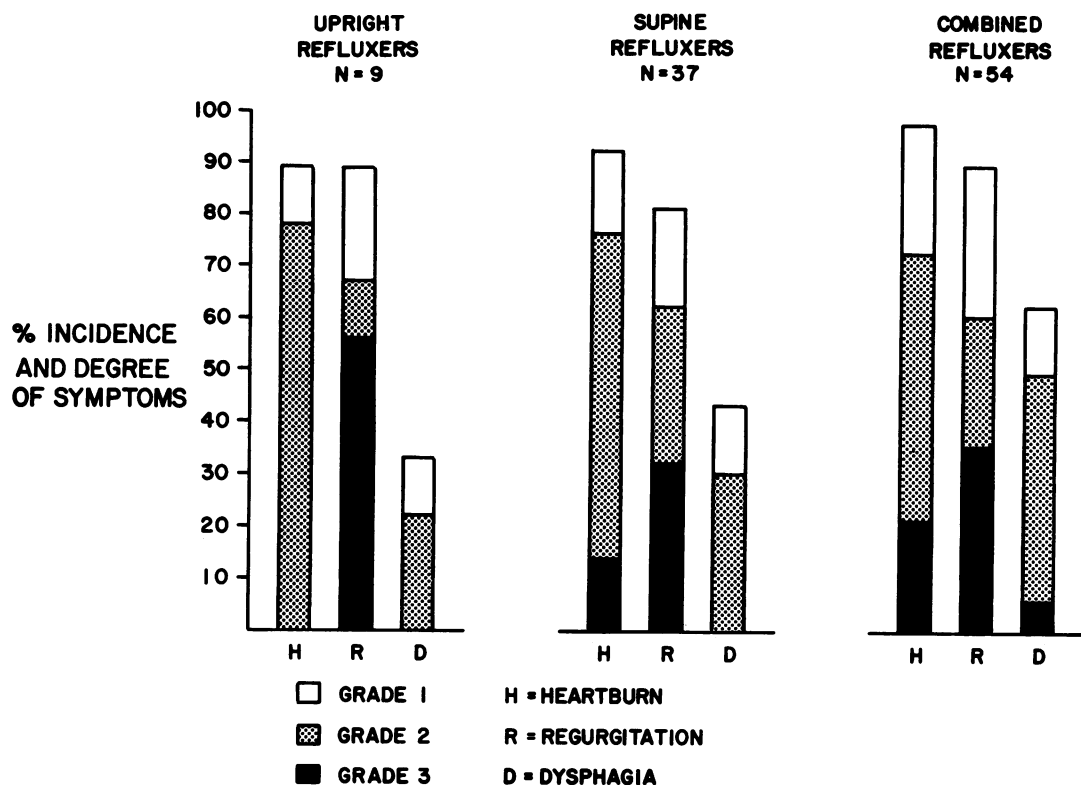


FIG. 7. Incidence and degree of symptoms of heartburn, regurgitation and dysphagia in symptomatic patients with various patterns of reflux.

with all patterns of reflux, but meat impaction secondary to an esophageal stricture was seen only in the combined refluxers. Occasionally, one was able to differentiate patients into upright, supine, or combined refluxers based on the time of day their symptoms occurred, but this was not consistent.

All of the symptomatic patients, regardless of the reflux pattern, had a significantly lower DES pressure than the control subjects. There was no statistical difference in the

DES pressure between patients with different patterns of reflux (Fig. 8). The amount of the DES exposed to the positive pressure environment of the abdomen was significantly less in the upright and combined refluxers than in supine refluxers and control subjects (Fig. 9). Between the latter, there was no difference. Both control subjects and the patients, regardless of their pattern of reflux, had the same degree and duration of DES relaxation on swallowing. Thirty-three per cent of the upright, 24% of

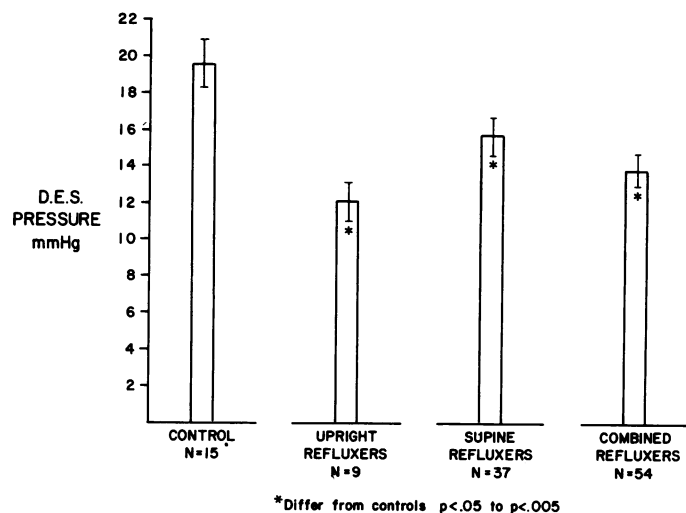


FIG. 8. Distal esophageal sphincter pressure in asymptomatic subjects and symptomatic patients with various patterns of reflux.

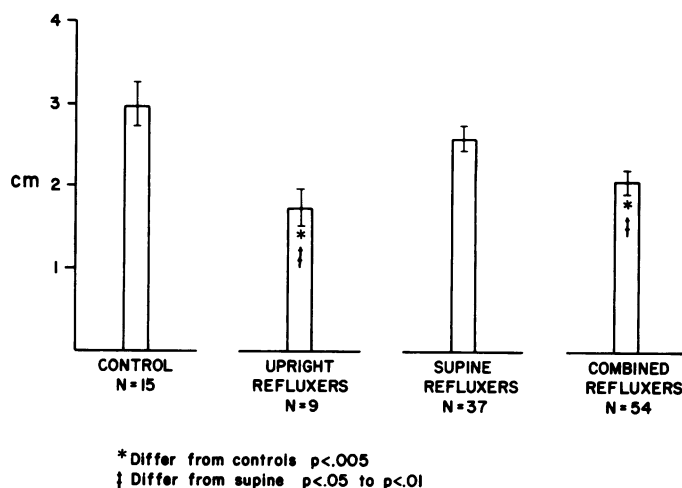


FIG. 9. Amount of distal esophageal sphincter exposed to the positive pressure environment of the abdomen in asymptomatic subjects and symptomatic patients with various patterns of reflux.

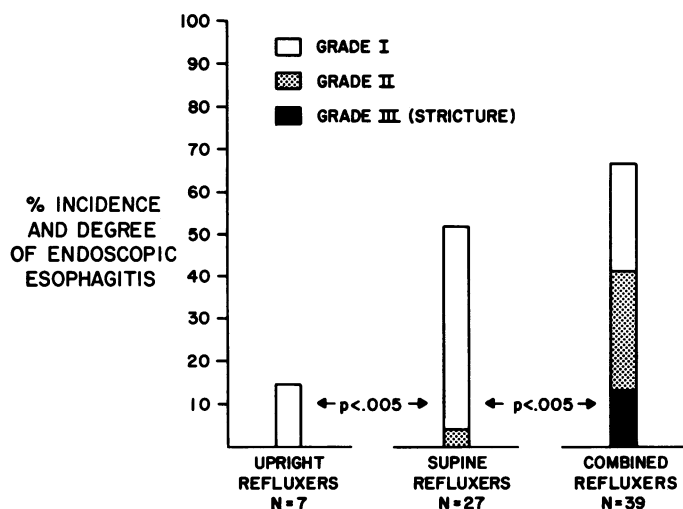


FIG. 10. Incidence and degree of endoscopic esophagitis in symptomatic patients with various patterns of reflux.

the supine, and 31% of the combined refluxers had some manifestation of an esophageal motor abnormality.

On endoscopy, there was a statistical difference between patients with different reflux patterns and the presence and degree of esophagitis. Supine refluxers had statistically more esophagitis than upright refluxers, and combined refluxers had statistically more esophagitis

than supine refluxers (Fig. 10). Only grade I esophagitis was seen in upright refluxers and stricture was only seen in combined refluxers.

Antireflux procedures were effective in reducing the per cent time the pH was less than 4 on 24-hour monitoring of the distal esophagus to normal in patients who underwent surgical therapy regardless of their pattern of reflux. The postoperative values were similar to that observed in the control subjects with the exception that upright refluxers had less postoperative upright reflux than control subjects (Fig. 11).

Concomitant with post-surgical improvement in the per cent time the distal esophagus was exposed to acid, there was an increase in the DES pressure to control levels in all patients regardless of their reflux patterns. This was not statistical for upright refluxers because of the small number of patients operated upon (Fig. 12). Similarly, the amount of DES exposed to the positive pressure environment of the abdomen, which was abnormal in the combined and upright refluxers preoperatively, was restored to normal postoperatively. This was significant for the combined refluxers and only approached significance for the upright refluxers because of their small numbers (Fig. 13).

Postoperatively, the incidence of abdominal distention was most common in upright refluxers (Fig. 14).

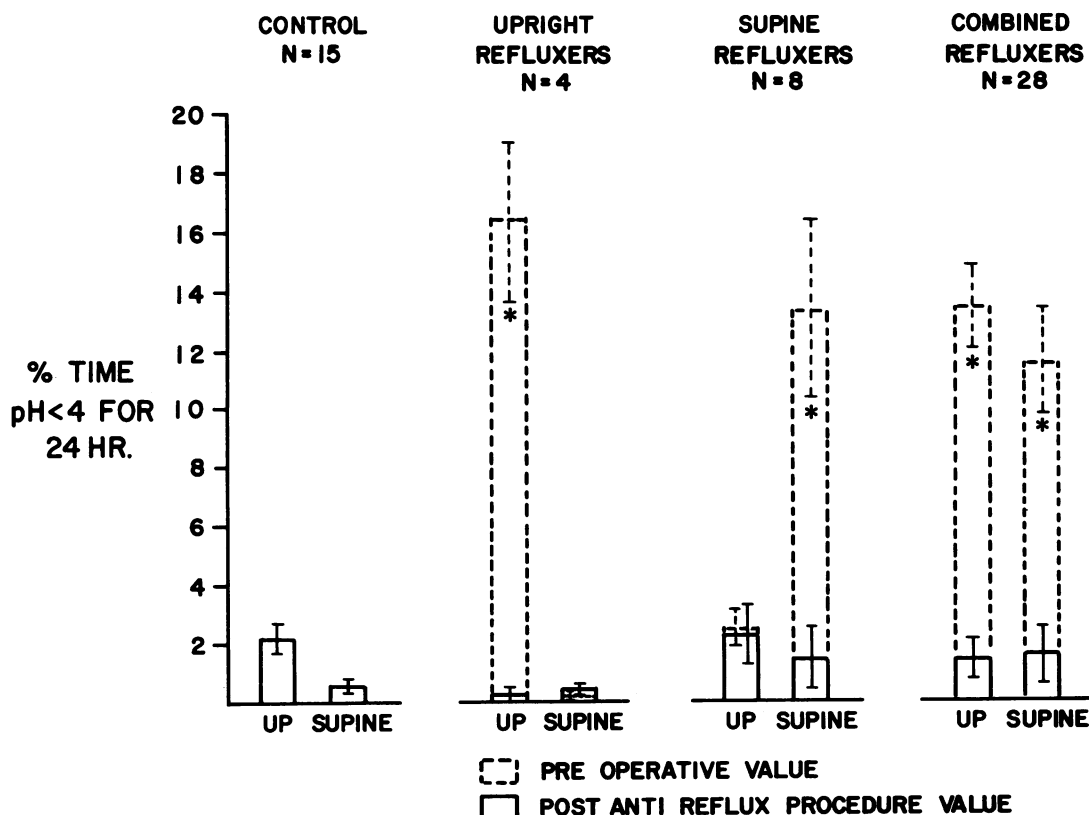


FIG. 11. The results of 24-hour pH monitoring of the distal esophagus in 15 asymptomatic subjects and 40 patients before and four months after a surgical antireflux procedure. \* Differ from postop values  $P < 0.05$  to  $P < 0.005$ .

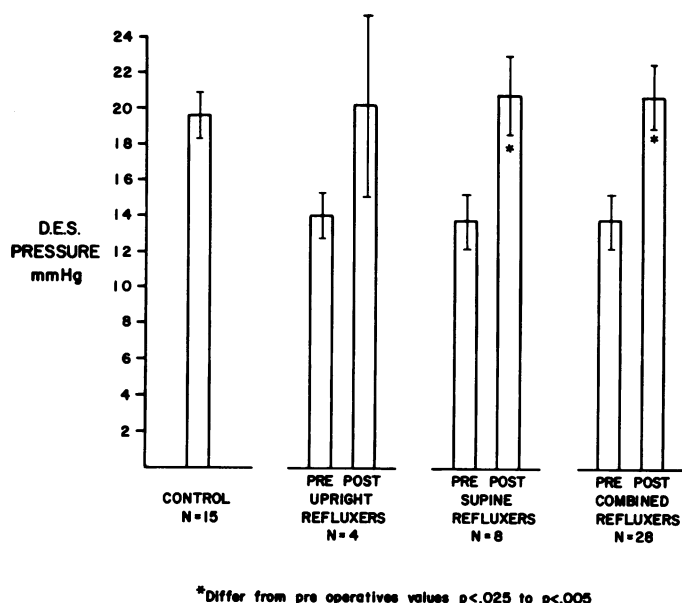


FIG. 12. Distal esophageal sphincter pressure in 15 asymptomatic subjects and 40 patients before and four months after a surgical antireflux procedure.

The only patient admitted to the hospital for a severe episode of post-prandial abdominal distention following an antireflux repair was an upright refluxer. This episode occurred two months after surgery and required an overnight hospital admission in order to decompress the patient's stomach with a nasogastric tube. On passage of the tube, there was an immediate release of air associated with relief of the patient's abdominal pain. These episodes of abdominal distention continued to plague the patient for 1½ years following his antireflux repair. They have since ceased and he has been free from this complication for the past 2 years.

The swallowing of air causes oral eructations associated with an upright reflux episode and was commonly seen in both upright and combined refluxers. Continuation of habitual aerophagia following the surgical construction of a competent sphincter results in increased amounts of flatus and can be used as a means of determining the contribution of aerophagia to the etiology of the patient's upright reflux. All patients with isolated upright reflux had excessive postoperative flatus. This was less common in combined refluxers, and minimal in supine refluxers (Fig. 14).

### Discussion

The results of these studies show that human subjects with a normal cardioesophageal junction reflux more in the upright position, particularly after meals, than when recumbent and sleeping. This observation suggests that factors other than gravity influence reflux in the upright position. Johnson<sup>6</sup> has measured gastroesophageal pres-

sure profile in the erect position and showed that a pressure drop of 12 mm Hg existed between the stomach and the mid-esophagus. Similarly, Thurbeck<sup>9</sup> has shown in animals that the recumbent gastroesophageal pressure gradient was less than that observed upright. These studies indicate that there normally exists an intraluminal pressure gradient encouraging the reflux of gastric acid into the esophagus in the upright position. During one's waking hours, he is unable to sit down or get up, lift burdens, walk, breathe deeply, speak loudly, cough, or defecate without producing marked changes in intra-abdominal pressure. Such changes in intra-abdominal pressure can, on occasion, overcome the DES pressure and allow the reflux of acid into the esophagus which is rapidly cleared by swallowing.

The intraluminal pressure in the DES equals the intra-abdominal pressure plus the distal esophageal muscle tone. The intragastric pressure at the cardia equals intra-abdominal pressure plus a small contribution from gastric muscle tone. The only force tending to open the cardia and to cause gastroesophageal reflux is the difference between intragastric and intra-abdominal pressure. If sufficient length of the DES is exposed to the positive pressure environment of the abdomen, only the tiny portion of intragastric pressure due to gastric muscle tone is all that has to be controlled by the DES muscle. Over 99% of intragastric pressure is derived from and varies with intra-abdominal pressure.<sup>2</sup> Any alteration of this due to straining, etc., is therefore exactly matched by a concomitant increased compression of that portion of DES exposed to abdominal pressure with no extra tone being required of the sphincter muscle.

In the current study, patients with symptomatic reflux, regardless of the pattern demonstrated, had DES pres-

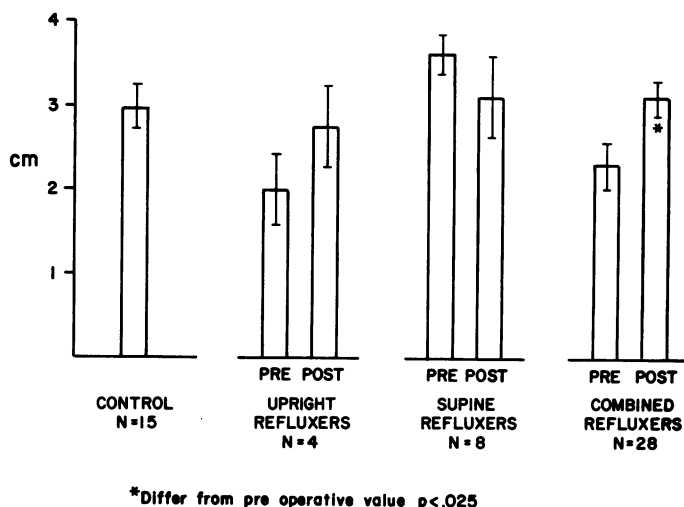


FIG. 13. Amount of distal esophageal sphincter exposed to the positive pressure environment of the abdomen in 15 asymptomatic subjects and 40 patients before and 4 months after a surgical antireflux procedure.



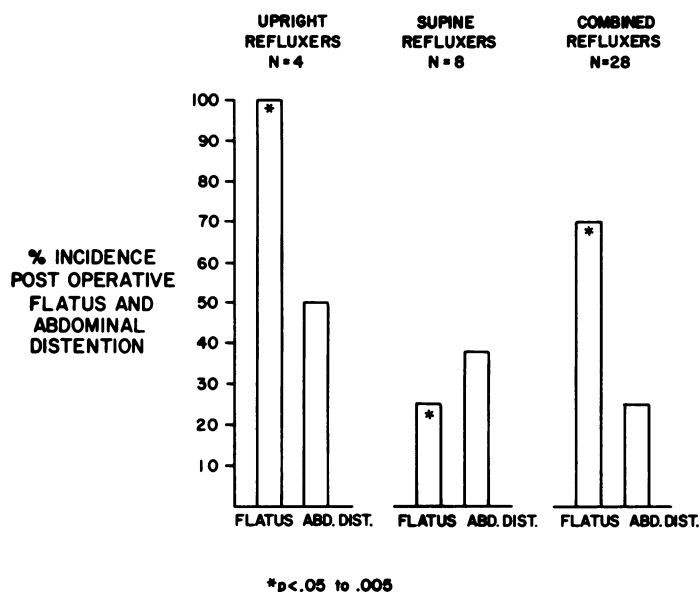


FIG. 14. Incidence of post-operative flatus and episodes of abdominal distention in 40 patients with various patterns of reflux 4 months after a surgical antireflux procedure.

tures statistically less than that of control subjects; and upright and combined refluxers had statistically less of their DES exposed to the positive pressure of the abdomen than did the control subjects or patients who refluxed only in the supine position. Patients with a low DES pressure and insufficient length of sphincter exposed to the positive pressure environment of the abdomen would have greater difficulty in compression of the DES with increases in abdominal pressure, and would be predisposed to upright reflux. Patients with a low DES pressure, but a normal amount of DES exposed to the positive pressure environment of the abdomen, would be able to compress their DES with increases in abdominal pressure, but would have insufficient DES muscle tone to match changes in gastric muscle tone and be predisposed to a supine reflux pattern.

The question arises, why do upright refluxers not reflux in the supine position since they have both a low DES pressure and less length of sphincter exposed to the positive pressure of the abdomen? It is our subjective impression that these patients have hyperactive gastrointestinal motility, and as a result, quickly evacuate any contents from the esophagus, including air, even during the supine hours when the normal esophagus is quiescent. Most of the upright reflux these patients have occurs within a two hour period after meals, and is an exaggerated post-prandial physiological reflux. This has suggested to us that these patients may have difficulty in emptying their stomach after meals. We have recently obtained a gastric emptying curve using a radioisotope meal in one of the patients with upright reflux. The observed emptying curve (Fig. 15) differs from the

normal expodistal decrease by plateauing within the first 40 minutes following a meal for a period of an additional 40 minutes during which the gastric volume remains constant, then rapidly empties. This may represent an episode of pylorospasm during a period of active gastric contractions which increase intragastric pressure above DES pressure, resulting in excessive post-prandial reflux.

Severe endoscopic esophagitis did not correlate to the presence of reflux symptoms and was seen only in patients with supine and combined reflux. Common to these patients was the prolonged clearance time following a supine reflux episode. This allowed prolonged contact of hydrochloric acid and activated pepsin with the lower esophageal mucous membrane. During waking hours in normal subjects, refluxed gastric contents are rapidly cleared from the esophagus by frequent swallowing. During sleep, however, there are prolonged periods when no swallowing takes place. Between these are interspersed periods of swallowing activity.<sup>7</sup> When reflux acid reaches the esophagus during the quiet nonswallowing periods of

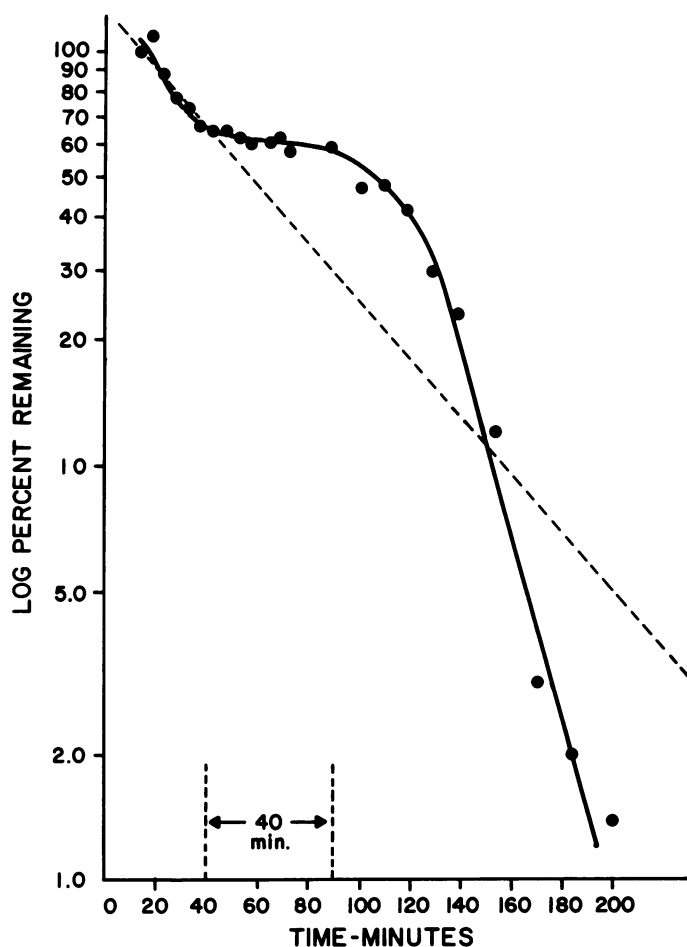


FIG. 15. Radionuclide gastric emptying time in a patient with isolated upright reflux showing a plateau after 40 minutes for a period of an additional 40 minutes followed by a very rapid emptying. The broken line represents the normal expodistal decline in gastric volume.

sleep, it remains in the lower esophagus until the onset of an active period of swallowing when it is rapidly cleared. We have shown that these long nocturnal reflux episodes provide for prolonged acid mucosal contact and contribute to the development of esophagitis followed by stricture formation.<sup>5</sup> This situation may be self-perpetuating in that patients with esophagitis, swallowing is less effective in clearing the esophagus. Booth<sup>1</sup> has demonstrated that patients with esophagitis have greater difficulty in clearing a 15 ml. bolus of 1 N hydrochloric acid placed within their esophagus. This probably accounts for the delayed clearance of an upright reflux episode in patients with a combined reflux pattern.

An esophageal motor abnormality can reduce the effectiveness of clearing the esophagus of reflux contents due to disordered peristalsis. This, however, is not sufficient to explain the incidence of esophagitis in the different reflux patterns since each of the patterns of reflux had a similar incidence of esophageal motor dysfunction.

An antireflux procedure was equally effective in returning an upright, supine, or combined reflux pattern to normal. This was associated with a return in DES pressure to normal levels and a return of the normal amount of DES exposed to the positive pressure of the abdomen in both the upright and combined refluxers. It appears that antireflux procedures create a competent sphincter by correcting those specific sphincter abnormalities associated with incompetency.

Postoperatively, all upright refluxers had excessive flatus which reflects the habitual aerophagia observed in these patients. The habit is retained after surgery and contributes to their high incidence of post-prandial abdominal distention when compared to supine and combined refluxers. Severe postoperative abdominal distention following meals would be expected in a patient with excessive aerophagia who now has a competent sphincter. This would especially be so if he has an associated pylorospasm. Indeed, the most severe episode of postoperative abdominal distention following meals was noted in an upright refluxer and he was the only patient who required admission to the hospital for relief of severe abdominal distention.

Currently, we have elected to withhold surgical therapy on patients with isolated upright reflux because of the low incidence of esophagitis seen with this pattern of reflux and their propensity to have postoperative problems with flatus and post-prandial abdominal distention. If, on further investigation, an abnormality in gastric emptying or pyloric function is established in these patients, a pyloroplasty with or without an antireflux procedure might be a more appropriate operation.

Patients with supine and combined reflux patterns have

a high incidence of esophagitis and are best treated with a surgical antireflux procedure. We have attempted medical treatment of these patients with bethanechol and elevation of the head of the bed.<sup>4</sup> The results, based on 24-hour pH monitoring of the esophagus, did not approach that obtained in similar patients treated with an antireflux procedure. If abnormal reflux can be shown in both the upright and supine position, even in the absence of endoscopic esophagitis, early operative therapy should be encouraged since these patients are at risk in developing esophagitis and strictures. It is important to emphasize that this high risk group is not confined to patients with significant symptoms. It has been the experience of most physicians dealing with this disease that patients may present for the first time with severe esophagitis without having any previous reflux symptoms. Skinner found that the development of esophagitis and stricture was not related to the presence of or severity of symptoms of esophageal reflux. Out of 226 patients with esophageal strictures, 20% did not have reflux symptoms severe enough to require medical attention prior to the development of dysphagia. Patients rejected for surgical treatment of reflux because of their symptoms were mild, sometimes returned with a fully developed stricture or advanced esophagitis. The 24-hour pH monitoring of the esophagus allows the identification of these high risk patients and avoids this potential mismanagement.

### Conclusions

It is concluded that minimal reflux is physiological and the normal cardia is more competent supine than in the upright position. Physiological reflux is unaffected by age, rarely occurs during slumber, and is the rule after alimentation. There are three patterns of pathologic reflux seen in symptomatic patients and all have a DES pressure less than control subjects. Patients with upright reflux alone or in combination with supine reflux have less of their DES exposed to the positive pressure of the abdomen when compared to control patients or patients with only supine reflux. Patients with isolated upright reflux have excessive aerophagia and a high incidence of postoperative flatus and abdominal distention. Patients with supine reflux have an inability to clear their esophagus of reflux acid and as a result, are prone to develop esophagitis. Patients who have both upright and supine reflux have severe esophagitis and are at risk in developing strictures. Early antireflux surgery should be applied to such patients in lieu of persistent and prolonged medical management. Antireflux procedures are able to stop pathologic reflux by correcting those specific DES abnormalities associated with incompetency.

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## DISCUSSION

DR. ROBERT E. CONDON (Milwaukee, Wisconsin): I share many views with Tom DeMeester, Dave Skinner and the University of Chicago group about the problem of reflux esophagitis; in particular, I have found that continuous pH monitoring is a useful technique to detect subtle episodes of reflux in patients in bed at night, when they are asleep.

I would like to comment about the significance of measurement of pressures in the lower esophageal sphincter area as a diagnostic criterion in patients who have reflux esophagitis. We have recently reviewed the results of esophageal manometry studies in my last 50 private patients who have had a fundoplication for reflux esophagitis. The studies were done by my Milwaukee gastroenterology colleagues, whom I expect most of you will recognize as both technically competent and reliable.

We found that, although patients with symptomatic reflux do have mean lower esophageal sphincter pressures, taken as a group, than normal controls, there is a significant overlap between normals and symptomatic patients. Indeed, about a third of reflux patients have absolutely normal lower esophageal sphincter pressures preoperatively, and a couple of patients have had above normal lower esophageal sphincter pressures.

I think, therefore, that measurement of pressure in the lower esophageal sphincter is not a reliable diagnostic criterion to establish the presence or absence of symptomatic reflux esophagitis. I emphasize this point because I continually run into confusion among my nonsurgical colleagues about it. I repetitively see patients who should have been, in my view, referred earlier for surgical cure of their reflux, and who have not been referred because they have a manometry pressure which was in the normal range.

I suppose, as in many other areas, simple things really are best. The most reliable diagnostic test we have found is the Bernstein test in which the instillation of acid into the esophagus reproduces the patient's symptoms. It's simple to do, and the end result is obvious to all.

DR. A. P. NAEF (Lausanne, Switzerland): I would like to discuss the practical importance of this test for our indications and postoperative controls of antireflux operations.

Dr. DeMeester has shown elsewhere that there is no correlation between reflux symptoms and endoscopic esophagitis, and he has also shown that the Nissen-procedure seems to be the best antireflux operation. Thus, 24-hour reflux monitoring would be extremely interesting to test the efficacy of a technique, we have used in very special cases, namely the intrathoracic fundoplication.

In our series of 727 operations for hiatus hernia, we have 55 cases of severe Grade 2 and 3 esophagitis, 15 with strictures. While in most cases results were satisfactory when the reflux was eliminated by a straightforward subdiaphragmatic fundoplication, we have 5 cases where a short esophagus was so pronounced that we had to leave the

wraparound deliberately in an intrathoracic position. This operation, where a "legalized" hiatus hernia is surgically established, is admittedly a somewhat controversial technique, but it works.

In all these cases, early postoperative esophagoscopy has shown that esophagitis and strictures disappear in a matter of days. However, in some of these elderly, debilitated patients, the postoperative course was somewhat difficult, due to temporary dilatation of the intrathoracic stomach, resulting in cardiac problems, such as arrhythmia and tachycardia; but there were no serious complications, such as perforation or hemorrhage.

One of our Swiss colleagues, Dr. Maurer of Solothurn, has still a much greater experience of 15 intrathoracic "Nissens" with no deaths, no serious complications, no failures, and 8 excellent and 7 good results.

We recently switched to the Collis-Belsey gastropasty, but were impressed with residual esophagitis at early postoperative esophagoscopy. This may be explained by residual reflux because the Belsey technique is not a total wraparound, and may be by some minimal peptic secretion in the gastric tube.

In conclusion, we believe that, given a good indication, the intrathoracic Nissen is the better antireflux procedure, whereas the gastropasty may be easier in the immediate postoperative course. We still do not seem to have the final answer, but this test Dr. DeMeester described may help us for indications and follow up of some of these difficult operations.

DR. HIRAM C. POLK, JR. (Louisville, Kentucky): I think that Dr. DeMeester did not have the time to touch on some very important implications that are in his manuscript. This, of course, is part of a very careful continuing effort on the part of Dr. DeMeester and Dr. Skinner to characterize this disease that has been so difficult to define, both in terms of its indications for operation and the benefit therefrom.

As I read this, there is obviously a better understanding of what is normality, and I think that immediately raises a question about which I would like to hear Dr. DeMeester's speculations. That is, why, for example, does the patient reflux less often—the normal patient—in the supine position than in the upright position?

The other point related to the clearcut definition of those patients who are very likely to suffer from so-called gas bloat syndrome, those patients he identified as being upright refluxers. While they are very likely to develop complications from the antireflux procedures, particularly the Nissen fundoplication operation, I wonder what he proposes for this group? I wonder, most particularly, how confident he is of the observation that these patients are not likely to do well, when those observations were based on 4 patients. This, of course, is more than the rest of us have studied, but I wonder whether this is a confident observation, or a simple hypothesis at this time.

There is a clearcut identification of those groups of patients who benefit from operation, and even those groups with the combined reflux, i.e., supine and upright, who seem to be at a risk of developing a real, significant stricture in a very prompt period of time, and are very clear candidates for operation.